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reacts in a precise way to a far wider range of external conditions.

Seasonal variations, as was pointed out by Weismann, show a hereditary tendency to alternate which, in some cases, is independent of external conditions.

Seasonal varieties are in some cases (*e. g.*, *Colias*, and possibly *Araschnia*) to be regarded as distinct ontogenetic stages. Cold arrests development at an early phase in color metabolism, and the mature insect emerges with pale colors (*Colias eurytheme* var. *ariadne*), or with a color pattern different from the definitive coloration of the species (*Araschnia levana*).

The suggestion is made that local color varieties, passing it may be for distinct species, are probably in some cases the equivalents of seasonal variations. That is, they are the product of a genotype sensitive to environmental changes expressing itself under a particular set of local climatic conditions; elsewhere the same genotype may respond quite differently. Such phenomena, though not of profound evolutionary significance, may play a rather conspicuous rôle in the evolution and diversification of the colors of animals and plants.

JOHN H. GEROULD

#### VARIATIONS IN THE VERMILION-SPOTTED NEWT, *D. VIRIDESCENS*

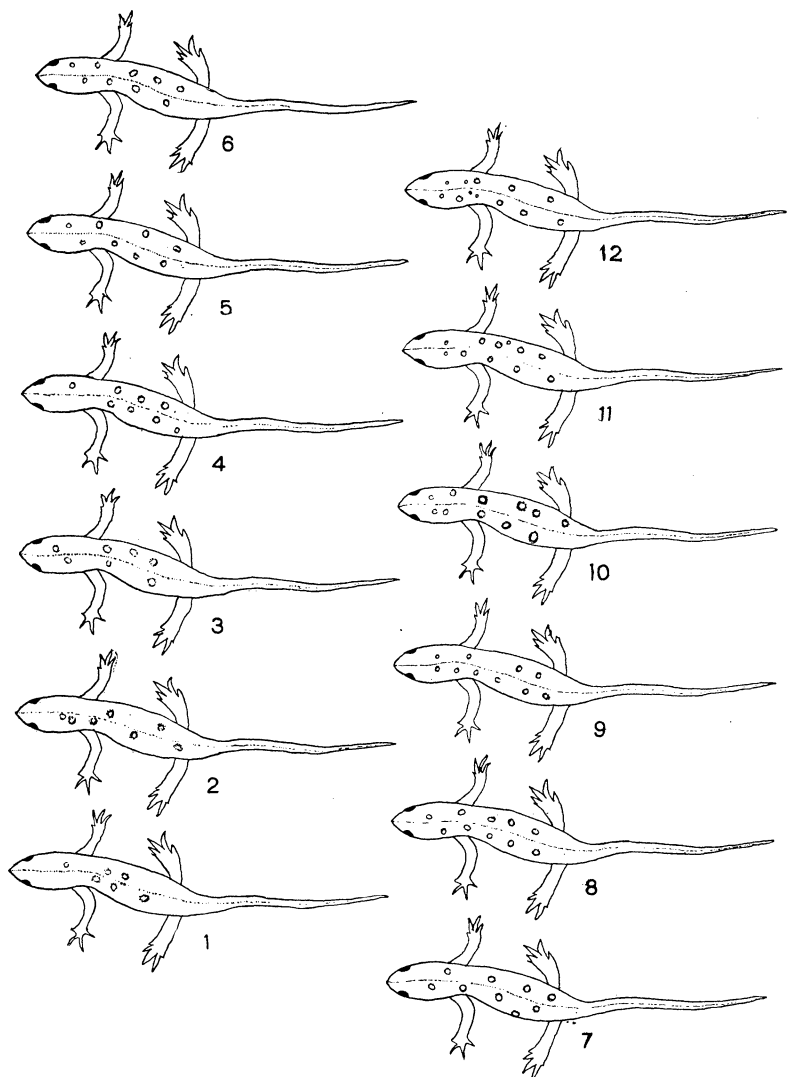
WHILE carrying on some experiments with the spotted newt, *Diemyctylus viridescens*, I was struck with the variation in the size, number and arrangement of the black-bordered vermilion spots so characteristic of this beautiful little salamander.

It is now generally recognized that this species exhibits two phases which were formerly described as distinct varieties or even species. As described by Gage<sup>1</sup> the young animal, which is terrestrial in habits, is red in color and was formerly called *D. miniatus*; later it becomes aquatic and its ground-color becomes olivaceous—permanently so, according to Gage. Against this dark ground-color (which is subject to considerable variation under different conditions even in the same individual) the bright red spots with their black borders stand out very strikingly.

It was with the olivaceous phase that I was experimenting, and it is upon this phase that the following observations are based.

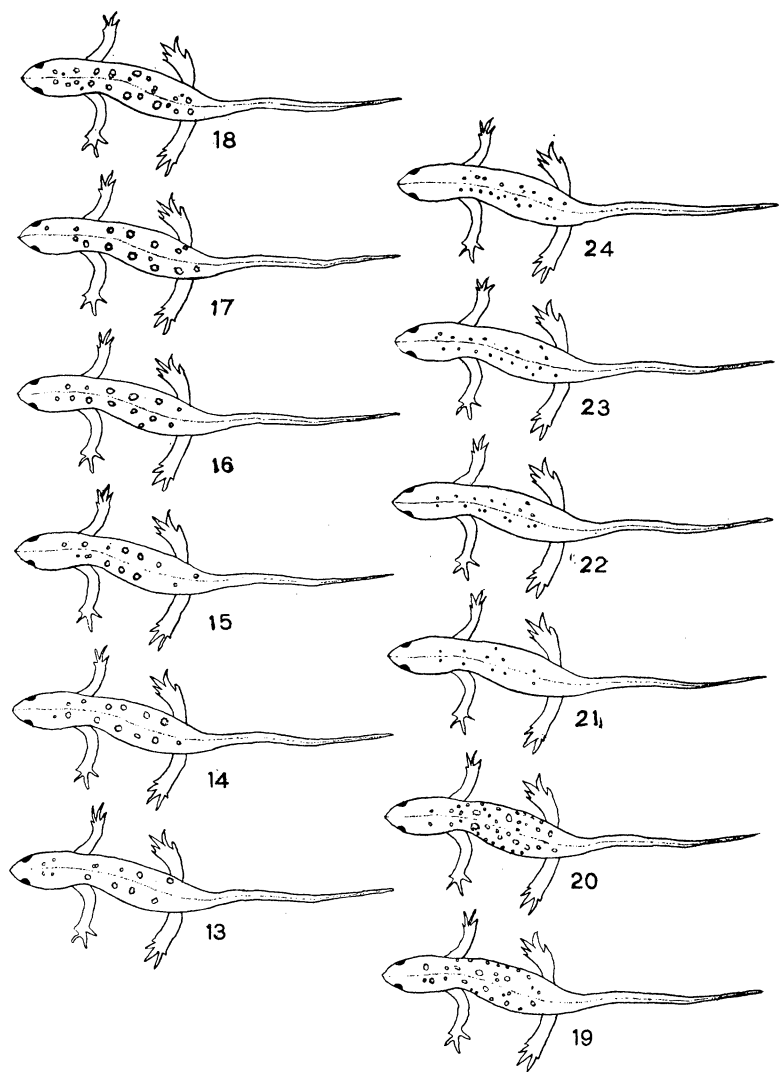
<sup>1</sup> Gage, S. H., "The Life-History of the Vermilion-Spotted Newt," AMER. NAT., December, 1891, pp. 1084-1103.

All the drawings were made from preserved material in which the vermilion spots had mostly faded to a white or pale pink color.



The first twenty figures were made from about three dozen specimens, probably all from the neighborhood of Morgantown. The last four figures are from animals that had been obtained from the Marine Biological Supply Company, Woods Hole, Mass.,

and had died, from time to time, in the laboratory aquaria. The mid-dorsal ridge is indicated in the figures by the dotted line.



Only the black-bordered vermilion spots were noted, the small black spots being too numerous and irregular to make it worth while to study them.

It will be noticed that in the animals from Woods Hole, shown in figures 21 to 24, the red spots were much smaller than most of

those on the animals from Morgantown. This was true of nearly but not quite all of the animals obtained from the north.

Cope says:<sup>2</sup>

On each side of the vertebral line is a row of from three to six small round red spots, each with a black border. The rest of the surface is marked with small black points, which are smaller but more distinct on the lower surface.

Among all of the animals examined no two were spotted alike.

They were sorted into groups according to the total number of red spots. The smallest number of red spots found was six; they were all of large size and arranged as shown in Fig. 1; only one animal with this number of spots was found.

Four animals were found that had seven red spots; Figs. 2 and 3 show the arrangement of the spots on two of these animals; all of the spots were large and of about the same size.

Four animals exhibited eight red spots, mostly large and of uniform size; two arrangements are shown in Figs. 4 and 5.

Three animals had nine red spots each, mostly large and of uniform size; Figs. 6 and 7 show two arrangements of these spots.

Seven animals had ten red spots each, this being the largest number of animals found in any group. The spots were mostly large and uniform in size; two arrangements are shown in Figs. 8 and 9. It will be noticed that in Fig. 8 the spots are arranged in fairly regular pairs.

Five animals had eleven red spots of somewhat more variable size than in the preceding. Figs. 10 and 11 show two arrangements of these spots; and Fig. 10, especially, shows wide variations in the size of the spots.

Three animals exhibited twelve red spots of variable size, two arrangements of which are shown in Figs. 12 and 13.

Two animals, shown in Figs. 14 and 15, exhibited thirteen red spots of various sizes.

Two animals had fourteen red spots; one of these animals is shown in Fig. 16.

Figs. 17, 18, 19 and 20 show the arrangements of red spots on four animals that had 15, 24, 29 and 39 spots, respectively. It will be noticed in these animals, especially in the last, that the large number of red spots is due to an increase in the number of very small spots, the number of large red spots being no greater than in the earlier individuals. Thirty-nine was the largest num-

<sup>2</sup> Cope, E. D., "The Batrachia of North America," *Bull. U. S. Nat. Mus.*, No. 34, 1889, p. 210.

ber of red spots found on any single animal. Only one animal in each of these last five groups was found.

Figs. 21 to 24, as noted above, represent animals obtained from Woods Hole; they have 11, 16, 19 and 20 spots, respectively, and it will be noted that all of the spots are small and of fairly uniform size.

#### CONCLUSION

It would seem from this hurried survey that the number, size and arrangement of the vermilion spots, so characteristic of *D. viridescens*, are quite variable, probably two animals very seldom being even approximately alike.

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